APISARA

OILS, BUTTERS AND FATS IN SOAPMAKING

Understand their properties, choose them and build a balanced formula

FORMULATE BY FUNCTION, NOT BY REPUTATION

> An oil is not inherently “good” or “bad”. In soapmaking, its value depends on its composition, quality, proportion in the formula and the result being sought. This guide aims to move beyond a catalogue of oils toward a genuine formulation logic.

This guide covers: triglycerides and fatty acids • saponification value • lauric, palmitic, stearic, oleic, linoleic and ricinoleic profiles • hardness • solubility • lather • oxidative stability • virgin or refined oils • substitutions • cost • availability • local fats • formulation method.

Eric Bertrand for Apisara Free knowledge base for hobbyists, artisans, professionals and trainers.

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1. A fat is first and foremost an assembly of molecules

The oils and butters used in soapmaking consist mainly of triglycerides: one glycerol molecule linked to three fatty acids. During saponification, the alkali converts these triglycerides into fatty-acid salts — soap — and releases glycerol.

It is therefore not the commercial names “olive”, “coconut” or “shea” that directly determine soap behaviour, but primarily the fatty-acid profile contributed by each fat, together with its unsaponifiable fraction, oxidation state and processing conditions.

CENTRAL IDEA

Two different oils may perform a similar function if their profiles are comparable. Conversely, two apparently similar vegetable oils can produce very different soaps if their fatty-acid profiles differ.

2. The main fatty acids useful to the formulator

Fatty acid	Family	Typical contribution to soap	Point to watch
Lauric	Saturated C12	Soluble soap, quick abundant lather, high cleansing power.	At high levels, may feel strongly defatting depending on formula and use.
Myristic	Saturated C14	Supports lather, solubility and early hardness.	Same logic as lauric: consider the total proportion.
Palmitic	Saturated C16	Hardness, structure, creamier lather and bar integrity.	Very high levels may give a less soluble, less lively-lathering formula.
Stearic	Saturated C18	Hardness, structure, dense/creamy lather.	Can accelerate thickening and complicate some swirl designs.
Oleic	Monounsaturated C18:1	Mild use profile, less brittle soap, versatile formulation.	Very oleic soaps may harden more slowly and lather modestly at first.
Linoleic	Polyunsaturated C18:2	Contributes to a mild, flexible formulation profile.	More oxidation-sensitive.
Alpha-linolenic	Polyunsaturated C18:3	Provides a highly unsaturated fraction.	More delicate oxidative stability.
Ricinoleic	Hydroxylated C18:1	Castor oil specialty: helps lather stability/solubilisation and changes texture.	At high levels, can make a sticky or highly soluble bar.

3. Saponification value: essential for calculation

The saponification value expresses the amount of alkali required to saponify a given mass of fat. In laboratory practice it is classically expressed as milligrams of KOH per gram of fat. Soap calculators convert these data to determine the required NaOH or KOH.

The value differs because fats do not have identical fatty-acid distributions and natural raw materials show real variability. Calculation databases therefore use representative values. For demanding professional use, supplier batch specifications may be relevant when available.

SAFETY RULE

Any substitution of an oil or butter requires the alkali amount to be recalculated. Never replace a fat in a formula while automatically keeping the same amount of lye.

4. The lauric family: coconut, palm kernel and related fats

Coconut and palm-kernel oils are rich in lauric and myristic acids. They produce relatively soluble soaps with quick, abundant lather and strong grease-dispersing ability. They also contribute to bar hardness.

That effectiveness explains both their usefulness and the need to control their proportion. A body soap very rich in lauric lipids may be perceived as highly cleansing. The appropriate level depends on the product: toilet soap, household soap, soft or hard water, superfat, the other oils and expected use.

5. The structural family: palmitic and stearic

Fats rich in palmitic and stearic acids build bar structure and contribute to denser lather. They include palm oil, shea butter, cocoa butter and many animal fats.

They are not exactly interchangeable: shea, for example, combines substantial stearic and oleic acids and has a notable unsaponifiable fraction; cocoa butter has its own balance; palm is often particularly rich in palmitic acid. The complete profile must therefore be considered.

6. The oleic family: versatility and mild use profile

Olive oil is the classic example of an oleic-rich oil, but it is not alone: some high-oleic sunflower varieties, moringa, avocado and certain rapeseed oils also contain substantial oleic fractions.

A high oleic proportion can produce highly valued soaps, but an oleic-rich bar does not behave like one rich in palmitic/stearic acids. Unmoulding hardness, curing speed, solubility and lather character develop differently.

7. Polyunsaturated oils: useful, but to be balanced

Conventional sunflower, soybean, grapeseed and some seed oils can be rich in linoleic acid; flax and several other oils provide more alpha-linolenic acid. These materials can certainly be used in a formula, but their high unsaturation generally increases oxidation sensitivity.

The question is therefore not “can this oil be used?”, but: at what proportion, with what freshness, for what intended shelf life and with what overall oxidation-prevention strategy?

8. Castor oil: an unusual fat

Castor oil is dominated by ricinoleic acid, a hydroxylated fatty acid that is uncommon among everyday oils. In soapmaking, a moderate proportion is often used to support lather and modify solubility and texture.

It is misleading, however, to describe it simply as “the oil that makes lather”. It acts within the overall formula. A high proportion can strongly change texture, solubility and soap behaviour.

9. Virgin, refined and deodorised oils

Type	Possible advantages	Limits / points to control
Virgin / pressed	Sensory identity, colour, odour and minor fraction may be better retained depending on process.	Variability, odour/colour affecting soap, variable stability, cost.
Refined	Often more neutral profile, consistency, and better control of some impurities/contaminants depending on process.	Some minor compounds may be reduced; “less natural” is not a technical quality measurement.
Deodorised	More neutral odour, useful where fragrance or colour needs tight control.	Still verify specifications, origin and oxidative condition.

DO NOT CONFUSE “Virgin” does not automatically mean “better for soap”, and “refined” does not automatically mean “bad”. The right choice depends on actual quality, stability, cost, required consistency and product positioning.

10. The unsaponifiable fraction

A small part of some fats does not react like ordinary triglycerides with alkali. This unsaponifiable fraction may include sterols, tocopherols, hydrocarbons and other minor compounds.

It contributes to the identity of certain oils and butters, but significant skin benefits should not automatically be inferred in a rinse-off product exposed to an alkaline process. In professional formulation, claims should be supported by evidence appropriate to the finished product.

11. Comparative table of common fats

The profiles below are qualitative and deliberately simplified. Composition varies with cultivar, origin, season, extraction and refining. For lye calculation, use a reliable saponification database or supplier data — never this descriptive table.

Fat	Dominant profile / feature	Typical soapmaking role	Watch point
Olive	Very oleic	Versatile base; mild-use soap; benefits from cure.	Modest early lather; oil variability.
Coconut	Lauric + myristic	Fast lather, solubility, hardness, cleansing.	Adjust proportion to intended use.
Palm kernel	Lauric + myristic	Function close to coconut, with its own profile.	Do not assume exact equivalence with coconut.
Palm	Palmitic + oleic	Structure, hardness, creamy lather.	Document sourcing and environmental criteria.
Shea	Stearic + oleic; unsaponifiables	Structure, hardness, creamy character.	Cost, variability, possible faster thickening.
Cocoa butter	Stearic + palmitic + oleic	Hardness and structure; very firm butter.	Cost; may speed setting depending on formula.
Castor	Ricinoleic	Lather support, solubility, texture.	Excess: sticky / highly soluble bar.
Conventional sunflower	Often linoleic	Adds unsaturated fraction; economical in some regions.	Oxidation; distinguish from high-oleic.
High-oleic sunflower	High oleic	Useful oleic alternative, often relatively stable.	Confirm that the grade is truly high-oleic.
Rapeseed / canola	Oleic + linoleic; variable	Versatile liquid oil; regional availability.	Composition varies substantially by type/cultivar.
Soybean	Linoleic + oleic	Liquid oil, economical in some regions.	Oxidative stability must be considered.
Peanut	Oleic + linoleic	Versatile liquid-oil profile.	Allergen/traceability considerations and varietal composition.
Rice bran	Oleic + linoleic + palmitic	Fairly balanced profile; partial alternative to oleic oils.	Availability, quality and oxidation.
Sesame	Oleic + linoleic	Liquid oil; potential local identity.	Cost, odour/colour depending on grade.

Fat	Dominant profile / feature	Typical soapmaking role	Watch point
Avocado	Oleic, palmitic; unsaponifiables	Premium oil; oleic profile with minor fraction.	High cost; benefit should be justified in rinse-off product.
Moringa	Very oleic depending on quality/variety	Interesting local option for oleic profile and relative stability.	Price, availability, batch specifications.
Baobab	Oleic + linoleic + palmitic	Interesting local material with mixed profile.	Variability, cost and stability to document.
Animal fats	Often palmitic/stearic/oleic	Structure, hardness, longevity; possible local availability.	Origin, purification, odour, acceptability and regulation.

12. An expensive oil does not necessarily make a better soap

The commercial or cosmetic value of an oil does not directly predict its technical value after saponification. In a rinse-off product, a very expensive oil may provide a fatty-acid profile similar to a much cheaper material. Some of its distinctive compounds may also be transformed or diluted in the formula.

This does not make premium oils useless: they may serve local, sensory, marketing, traceability or differentiation goals. But a formulator should know what is being paid for and which measurable function is being sought.

QUESTION TO ASK BEFORE EVERY OIL

Is it present for its fatty-acid profile, stability, local availability, unsaponifiable fraction, commercial story, or simply because a recipe happens to use it?

13. Replacing an oil: why 20% for 20% is not necessarily equivalent

Replacing 20% olive oil with 20% coconut oil preserves the total oil weight but profoundly changes the fatty-acid profile, required lye amount, lather, solubility and use feel. Even two more similar oils can differ enough to alter the result.

A sound substitution therefore follows a method:

- 1. Identify the function of the material being replaced: lauric, structural, oleic, polyunsaturated, ricinoleic, etc.
- 2. Compare fatty-acid profiles, not merely liquid/solid state or price.
- 3. Check oxidative stability of the new combination.
- 4. Examine availability, cost, quality and consistency of supply.
- 5. Always recalculate the alkali with the new fats.
- 6. Recalculate formulation indicators and anticipate trace, unmoulding, cure and solubility.
- 7. Make a pilot batch and compare it with the control before approval.

14. Building a formula: think in functions

Question	What is being controlled	Families often used
Should the bar be firm and long-lasting?	Structure, hardness, dissolution rate.	Palmitic/stearic + overall balance.
Is quick lather needed?	Solubility and lather generation.	Lauric/myristic, complemented by the rest of the formula.
Is more stable/creamy lather wanted?	Lather texture and persistence.	Palmitic/stearic; ricinoleic as a complementary tool.

Question	What is being controlled	Families often used
What mildness profile is desired?	Balance of cleansing/superfat/lipid profile.	Oleic and overall formulation; control laurics.
What shelf life is required?	Resistance to oxidation.	Limit excessive sensitive polyunsaturates; use fresh materials and sound storage.
What is the target cost?	Raw-material cost without sacrificing function.	Optimise with local resources and validated substitutions.

15. Example of reasoning — without giving a universal recipe

Suppose a formulator wants a solid body soap with reasonably quick lather, good durability and accessible raw materials. Rather than copying a standard percentage, the reasoning might be:

- An oleic base for a versatile formula.
- A measured lauric fraction to provide lather and solubility.
- A palmitic/stearic fraction for structure and longevity.
- Optionally, a small castor fraction to modify lather behaviour.
- A polyunsaturated fraction compatible with the desired stability.
- A superfat, lye concentration and cure consistent with the whole formula.

The final formula will depend on available materials, climate, water used, cost, process, bar size and user expectations. This is precisely why there is no single universal ideal percentage.

16. Formulating with local raw materials

For an artisanal or educational project, local raw materials can be a major advantage: lower dependence on imports, greater resilience, product identity and sometimes a more coherent cost. But “local” does not remove the need for characterisation.

Moringa and baobab illustrate this approach well in several African regions. Their value should not be reduced to an exotic image: the formulator needs to know their fatty-acid profile, quality, variability, price, stability, actual availability and competition with food or other economic uses.

FRUGAL FORMULATION PRINCIPLE

The best oil is not necessarily the most prestigious. It is the one that fulfils the required function with controlled quality, realistic availability and a cost compatible with the product.

17. Sourcing: formulation continues at the supplier

- Clearly define the purchased material: botanical name or animal origin, grade, refining, and any hydrogenation/fractionation.
- Keep technical data sheets, certificates of analysis when available and batch numbers.
- Check odour, colour and packaging condition at receipt.
- Establish internal acceptance criteria appropriate to the scale of production.
- Compare supplier or batch changes where the profile may affect production.
- Plan stock rotation and avoid purchasing volumes disproportionate to consumption.

18. The real cost of a fat

Price per kilogram is only part of the cost. A cheap oil may become expensive if it requires importation, causes losses, needs difficult storage or has poor stability. A more expensive oil may be rational if it simplifies sourcing or enables a more coherent formula.

Cost to consider	Examples
Purchase	Price/kg, minimum order, seasonal variation.
Logistics	Transport, customs, packaging, storage.
Production	Melting time, losses, filtration, trace behaviour.
Quality	Testing, rejected batches, stability, consistency.
Commercial	Positioning, continuous availability, reformulation if supply fails.

19. Classic mistakes when choosing oils

Mistake	Why it misleads	Better approach
Choosing an oil because it is “nourishing”	Soap is a rinse-off product and saponification transforms the material.	Define the technical function and remain cautious with claims.
Copying a percentage found online	Context, other oils and intended use may differ.	Reason from the overall profile and test.
Treating all liquid oils as equivalent	Oleic, linoleic and linolenic profiles behave differently.	Compare fatty-acid profiles.
Replacing an oil without recalculating lye	Saponification values differ.	Recalculation is mandatory.
Maximising “precious” oils	Cost rises without guaranteed technical benefit.	Use every material for an explicit reason.
Ignoring batch variability	A natural material is not a mathematical constant.	Specifications, traceability and pilot batches.
Neglecting oxidation	A pleasant new formula may age poorly.	Design for shelf life as well as initial performance.

20. Decision sheet before adding a new oil

Question	What to document
What function does it provide?	Lather, structure, oleic profile, stability, local identity, other.
What is its fatty-acid profile?	Supplier data or reliable references; expected variability.
What is its saponification value?	Value used by the calculator and consistency with the actual material.
How stable is it?	Oxidation sensitivity, packaging, storage duration.
What proportion is planned?	Effect on the overall profile, not merely one isolated property.
What does it replace?	Function lost and function gained.
What is the process impact?	Trace, temperature, unmoulding, cutting, cure.
What is the economic impact?	Real cost, availability, minimum order, continuity.
Is the pilot batch satisfactory?	Production, use, cure, ageing and comparison with control.

21. From calculator to formulator judgement

A saponification calculator is essential for alkali calculation and can provide useful indicators for fatty acids or certain properties. But it does not experience the lather, automatically measure shower wear rate, know the quality of your oil batch or replace observation over several weeks or months.

The sound use of a calculator is therefore: calculate → anticipate → make → observe → compare → correct. Indicators are decision aids, not absolute quality scores.

22. The Apisara 8-step method for choosing fats

- 1. Define the soap's use. Body, hands, household, shaving, other.
- 2. Define priority performance. Hardness, lather, solubility, mild use profile, service life.
- 3. Inventory materials that are genuinely accessible. Price, quality, seasonality and logistics.
- 4. Read their fatty-acid profiles. Identify complementary functions.
- 5. Build the overall profile. Avoid judging one oil in isolation.
- 6. Check oxidation, superfat and process. A formula must age well and also be manufacturable.
- 7. Recalculate lye precisely and make a pilot batch.
- 8. Validate by observation. Unmoulding, cure, lather, use, solubility, ageing and user feedback.

KEY TAKEAWAY

A good soap is not formulated by adding together oils reputed to be “good”. It is built as a balance of fatty acids, process, stability, cost and use from raw materials that are actually available.

23. References and technical sources

Codex Alimentarius — Standard for Named Vegetable Oils (CXS 210-1999). Useful international reference for fatty-acid composition ranges and characteristics of many named edible vegetable oils.

FAO / WHO — Fats and fatty acids in human nutrition and resources on oils and fats. Background sources on lipid chemistry and composition.

Gunstone, Harwood & Dijkstra — The Lipid Handbook. Reference work on the chemistry, composition, properties and technology of oils and fats.

Bailey's Industrial Oil and Fat Products. Technical reference on fats and oils, their composition, processing and properties.

Supplier data and certificates of analysis. For professional formulation, specifications for the material actually purchased take precedence over generic values where differences are significant.

24. Disclaimer

This guide is an educational resource. Fatty-acid profiles and the characteristics of natural raw materials vary with origin, cultivar, season, extraction, refining and batch. This document does not replace supplier specifications, laboratory analysis, an SDS, a cosmetic safety assessment, or the regulatory obligations applicable to the product and country concerned.

The tables in this guide are intended to understand and compare. They must not be used as lye-calculation tables. Always use reliable saponification values and recalculate every formula after a change.

APISARA RESOURCES

In addition to the saponification calculator, apisara.org provides Apisara technical guides and reference sheets. Complementary educational articles are also published on Substack and Facebook.

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