

**Example calculation of margin of safety (MOS) for lavender oil at 0.5% in a women's body moisturiser
In compliance with EU regulation 1223/2009**

1. Composition of lavender oil (Lavandula Angustifolia Oil) from various literature sources

Linalool	30%
Linalyl acetate	33%
Ocimenes	8%
Beta-carophyllene	5%
Lavandulyl acetate	5%
Terpinen-4-ol	4%

Note: Like much of the research into essential oil composition the numbers are “typical” and don't add up exactly to 100%. In this case we have ignored components present at <3%.

2. NOAEL of linalool

The OECD has established a NOAEL of 117mg/kg/day based on a 28 day oral rat study (<http://www.inchem.org/documents/sids/sids/78706.pdf>). Higher daily doses caused liver toxicity. NOAEL values from reproductive and developmental toxicity studies were higher. The EU guidelines state that 90-day (sub-chronic) toxicity NOAEL values should be used in calculations on cosmetic products and it is generally accepted that this can be derived from a 28-day (sub-acute) study by application of an extra factor of 3. This gives an estimated 90-day NOAEL of 39mg/kg/day. Other expert groups such as the RIFM and JECFA have estimated (sub)-chronic toxicity NOAEL values of 50mg/kg/day, so our figure is in broad agreement with these.

3. Calculated NOAEL for lavender oil

The other main component linalyl acetate is known to hydrolyse readily in the body to linalool and the much lower toxicity acetate anion (see OECD SIDS for linalyl acetate). Based on molecular weight ratios 100g of linalyl acetate is equivalent to 78g of linalool. So the total linalool equivalent in lavender oil is $30\% + 0.78 \times 33\% = 55.7\%$. So just considering these 2 components, the NOAEL of lavender oil is $39\text{mg/kg/day} / 55.7\% = \underline{70\text{mg/kg/day}}$.

Of the other components, ocimenes are structurally very similar to myrcene which has a measured NOAEL of 250mg/kg/day. Terpinen-4-ol has a measured NOAEL value of 400 mg/kg/day with the critical effect being kidney toxicity. Beta-carophyllene is chemically similar to limonene but has higher molecular weight. The measured NOAEL of limonene is 250mg/kg/day so beta-caryophyllene would be expected to be higher still. Lavandulyl acetate is the ester of an alcohol that has similar chemical structure to other monoterpene alcohols and is expected also to have an NOAEL of >250mg/kg/day. In conclusion, the other components are much lower in toxicity than linalool and will not significantly change the overall toxicity of lavender oil, so the value to use is 70mg/kg/day.

4. Exposure to lavender oil

Amount of body moisturiser used per day = 123.2mg/kg/day

(generally used figure from SCCS guidelines)

Amount of lavender oil applied each day 0.5% x 123.2 = 0.62mg/kg/day

5. Systemic Exposure Dose (SED)

This is defined as the exposure in mg/kg/day x dermal absorption

We assume the amount of lavender oil actually absorbed through the skin to be 50%, as recommended in the latest SCCS guidelines. However, these guidelines also recommend applying a factor of 50% to the oral NOAEL values to convert to a “systemic NOAEL” (in the absence of other data). So these 2 figures cancel each other out in the final calculation and we simply ignore them.

$SED = 0.62 \times 100\% = 0.62\text{mg/kg/day}$

6. Margin of Safety (MOS)

This is defined as NOAEL/SED

$MOS = 70/0.62 = 113$

7. Conclusion

The margin of safety is greater than 100, so lavender oil at 0.5% in this product is considered to be safe.