Resin salve from Norway spruce 
(*Picea abies* [L.] Karst.)

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Conifer resin has been and is a source of various compounds in chemical industry
Tar production
Debarking →
Lightwood formation →
increased resin formation
Resin Salve

Spruce resin boiled (1:3) with ordinary butter

salve

Kolari
Lappish Resin Salve – traditional folk medicine

- Norway spruce (*Picea abies* (L.) Karsten)
- The resin is spread on sterile cotton gauze as an even layer of about 1 mm. The gauze is placed on the pressure sore and changed every 1-3 days. Treatment continues until the sore has closed, which will take from a few weeks to a few months.
Resin salve: empirically effective

- objectively effective? - clinical trial! antimicrobial?
- growth factors involved?
- mechanisms? - what are the effector substances?
- is the mechanism specific?
- product development?
- novel treatment mode?
Resin-Project

• Randomized clinical trial
  - 11 health centers enrolled
  - resin treatment vs. control treatment
  - at least 20 patients in both treatment arms

• Bacteriology
• Mycology
• Animal experiments – wound healing
• Chemistry
Resin – salve in skin pressure sores
Open prospective randomized clinical trial in
11 health centers
6 month trial

Resin group
13
↓
healed
12

Control group
9
↓
healed
4
Resin inhibits the growth of bacteria

MRSA

*Staphylococcus aureus*
Antimicrobial effect of resin on Gram+ staphylococci
No growth of MRSA in resin-pretreated FAB-medium

Fastidious Anaerobe Broth (FAB) (Lab M Ltd, Bury, England)
Pine and Spruce resin inhibit *Staph.aureus* but not *E.coli*
Pine and Spruce resin inhibit MRSA but not Pseudomonas
Antibacterial effect of spruce resin is bacteriostatic

Bacteria (MRSA) + resin in FAB

No growth of bacteria!!

inoculum of the FAB medium without resin

Bacteria grow!!
# Inhibitory effect of spruce resin on growth of bacteria

<table>
<thead>
<tr>
<th>Gram positive cocci</th>
<th>FAB</th>
<th>Resin-FAB</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em> (MRSA)</td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td><em>Staphylococcus epidermidis</em></td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td><em>Enterococcus faecalis</em></td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td><em>Enterococcus faecalis</em> (VRE) (vanB)</td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td><em>Enterococcus faecium</em></td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td><em>Streptococcus pyogenes</em> (A)</td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td><em>Streptococcus agalactiae</em> (B)</td>
<td>+++</td>
<td>-</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Gram positive rods</th>
<th>FAB</th>
<th>Resin-FAB</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Arcanobacterium haemolyticum</em></td>
<td>+</td>
<td>-</td>
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</table>

<table>
<thead>
<tr>
<th>Gram negative cocci</th>
<th>FAB</th>
<th>Resin-FAB</th>
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<tbody>
<tr>
<td><em>Escherichia coli</em></td>
<td>++++</td>
<td>+++</td>
</tr>
<tr>
<td><em>Enterobacter cloacae</em></td>
<td>++++</td>
<td>++</td>
</tr>
<tr>
<td><em>Klebsiella pneumoniae</em></td>
<td>++++</td>
<td>+++</td>
</tr>
<tr>
<td><em>Proteus vulgaris</em></td>
<td>++++</td>
<td>-</td>
</tr>
<tr>
<td><em>Proteus mirabilis</em></td>
<td>++++</td>
<td>+++</td>
</tr>
<tr>
<td><em>Pseudomonas aeruginosa</em></td>
<td>++++</td>
<td>+++</td>
</tr>
</tbody>
</table>

- No visible growth
- Slight
- Moderate
- Heavy
Resin salve

- objective antimicrobial effect (bacteria, fungi)
- likely bacteriostatic
- specific mechanism: inhibits Gram positive
  but not Gram negative (except *Proteus vulgaris*)
- antimicrobial effector dissolves quickly from resin to water (?) – resin itself is insoluble into water
- effective against MRSA!
Resin salve inhibits growth of fungi (Candida species)
• Mechanisms? - what are the effector substances?
Coumaric acid, resin acids and lignans dissolve into water from the spruce resin.
Phenylpropanoids are derived from **cinnamic acid**.
Norway spruce knots contain 6--24% lignans (HMR)
Strong antioxidants
Abietic acid – resin acids

- antibacterial – same antibacterial spectrum as with "Resin salve"
- rather poorly soluble into water
- however, resin acids dissolve into water in concentrations enough for antimicrobial effect (MIC 5-100 µg/ml)
- non-mutagenic (Ames test)
- irritant, allergic – used as an antigen (for resin allergy) in epicutan tests
- toxic to cells?
Resin was also mixed with four commercial salve: 
**Aloe vera** (Forever Living Products, USA). 
**Blocarnosin** (Bio-Vita Oy, Finland). 
**Ceridal** (Stiefel Laboratories Ltd., Ireland) and 
**Essex** (Schering-Plough Farma LDA, Portugal) in weight proportion of 1 to 3 (w/w).

The total amount of resin acids in the water phase (5 ml / 100 g salve) after 30 min sonication was: 
1.30 mg, 0.44 mg, 0.06 mg and 0.05 mg for Blocarnosin, Aloe Vera, Essex and Ceridal respectively.
Resin acid composition

- pimaric
- sandracopimaric
- isopimaric
- palustic
- levopimaric
- dehydroabietic
- abietic
- neoabietic

Legend:
- Wound resin
- Collected resin
- Induced resin
- Pine resin
- Pine induced
Norway spruce wound resin

![Graph showing abundance of compounds](image)

- **Coumaric acid**
- **Dehydroabietic acid**
- **Pinoresinol**

**TIC: PICRES48.D**

**Norway spruce wound resin**
Conclusions

Resin salve inhibited growth of Gram-positive bacteria.

However, results show that the resin composition is variable and may depend on resin collection and storage. Standardised manufacturing protocols need to be developed.

Blocarnosin seemed to be suitable for resin mixing instead of traditionally used salt-free butter.
Resin-Project Group

- 11 health centres (clinical trial)
- Study group members

Kolari
Muonio
Kemi
Rovaniemi
Jyväskylä
Paimio/Sauvo
Ristijärvi
Paltamo
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Prof Ilkka Harvima (KYS)
Thank you!

Dic Browne