A KNOWLEDGEBASE ANALYSIS OF ROSEMARY OFFICINALIS

By: Aneeta Uppal
Bioinformatics Ph.D. Student, UNC Charlotte
Aneeta Uppal

Aneeta is a second year Ph.D. student at the University of North Carolina at Charlotte in Bioinformatics. She received her undergraduate degree in Biotechnology from the Rochester Institute of Technology in 2015. She later moved to Charlotte and received her masters degree in bioinformatics at UNC Charlotte in 2016. She currently spends her time flipping between wet-lab science and computational biology. Her current research focuses on essential oils for human health.

Lori Pollock

Dr. Lori Pollock is a Professor in Computer and Information Sciences at University of Delaware. She earned her Ph.D. and M.S. in CS at the University of Pittsburgh. Her current research focuses on program analysis for building better software maintenance tools, software testing, energy-efficient software and computer science education. Dr. Pollock is an ACM Distinguished Scientist and was awarded the University of Delaware’s Excellence in Teaching Award and the E.A. Trabant Award for Women’s Equity. She leads the Partner4CS, a projects dedicated to integrating computer science in middle and high schools in Delaware through teacher professional development for the CS10K national efforts.
ESSENTIAL OIL (EO) INDUSTRY

• Exceeded USD 6.0 billion in 2015
• Large growth in consumer demand for EOs and all natural based products
• Hundreds of brands of oils are now on the market
• Not FDA regulated
WHAT IS AN EO? WHAT IS IN IT?

• EOs are volatile compounds extracted from a plant
• They are extracted or produced from:
  – Steam distillation (3 methods)
  – Cold-pressed extraction (citrus rinds)
  – Solvent extraction
CURRENT RESEARCH ON EOS

- About 16,000 published studies in NCBI Pubmed on EOs – not a lot compared to popular topics
- Many studies on the most popular oils (ex. Lavender)
- Are the claims what they are said to be?
- Can oils be used to target and treat specific health conditions and disease?
ROSEMARY APPLICATIONS ACCORDING TO A TRADITIONAL EO REFERENCE GUIDE

• For arthritis/muscle cramps (anti-inflammatory properties)
• Mental Fatigue – to enhance focus and prevent Alzheimer’s disease
• Has anti-cancer properties
• Can Rosemary do all of these things?! Maybe? But why, and how?!
• Extremely commonly used essential oil and herb
• GC/mass spec shows Rosemary is primarily composed of:
  – With small possible varying percentages
  – Based on chemotype, environment where it was grown, and time of harvest & distillation
HYPOTHESIS

• Using bioinformatics computational approaches, we can learn the possible health effects of Rosemary EO based on its chemical constituents.
METHODS: LINGUAMATICS
Reducing noise can be very difficult and takes most of my time...
METHODS: POSTGRESQL

Entity-Relationship Diagram
TAKING A CLOSER LOOK AT ROSEMARY

Microarray dataset of over-expressed/ under-expressed genes

Linguamatics chemical – gene associations of Rosemary constituents

Take Gene sets in common and look at the associated pathways
## GENE-CHEMICAL ASSOCIATIONS

### Database Query Results

```sql
```

```sql
SELECT * FROM ChemGenesLing JOIN public."Kegg_Gene_Info" ON (ChemGenesLing."EntrezGene_symbol" = "Kegg_Gene_Info"."GeneSym");
```

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<th>EntrezGene_symbol</th>
<th>ChemGene_Relation</th>
<th>GeneSym</th>
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<td>Calcium signaling pathway</td>
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COMPARING TO MICROARRAY DATASETS CAN PROVIDE GENES OF INTEREST

CREATE VIEW GSE56496OverExp AS
SELECT *
FROM GSE56496 JOIN ChemGenesLing ON (GSE56496."GeneSym" = ChemGenesLing."EntrezGene_symbol") WHERE GSE56496."Fold_change" > 1.4;

CREATE VIEW GSE56496UnderExp AS
SELECT *
FROM GSE56496 JOIN ChemGenesLing ON (GSE56496."GeneSym" = ChemGenesLing."EntrezGene_symbol") WHERE GSE56496."Fold_change" < 0.5;

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### HIGHLIGHTED RESULTS

<table>
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<th>Chemical</th>
<th>Relationship</th>
<th>Gene Symbol</th>
<th>Highlighted Pathways involved</th>
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<tbody>
<tr>
<td>1,8-cineole &amp; limonene</td>
<td>Increased expression</td>
<td>BAX &amp; BCL2</td>
<td>Colorectal, Small cell lung &amp; Prostate cancer</td>
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<td>IL10</td>
<td>Intestinal immune network for IgA production, Cytokine-cytokine receptor interaction, T cell receptor signaling pathway</td>
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<td>1,8-cineole</td>
<td>Increased expression</td>
<td>MME</td>
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<td>1,8-cineole &amp; limonene</td>
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<td>COL11A2</td>
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<td>HMGCR</td>
<td>Bile secretion, Terpanoid backbone biosynthesis</td>
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**Table 1:** Highlighted results of using the knowledgebase for the chemical constituents of Rosemary EO
**COMPARISONS**

<table>
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<tr>
<th>TimeStamp</th>
<th>Fold_change</th>
<th>GeneSym</th>
<th>PT_ChemTerm</th>
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<td>increased expression</td>
<td>T cell receptor signaling pathway</td>
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<table>
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**Artemisia princeps Pamp. Essential oil and its constituents eucalyptol and α-terpineol ameliorate bacterial vaginosis and vulvovaginal candidiasis in mice by inhibiting bacterial growth and NF-κB activation.**

Trinh HT, Lee JA, Hyun YJ, Kim DH

© Author information

**Abstract**

To investigate the inhibitory effects of Artemisia princeps Pamp. (family Asteraceae) essential oil (APEO) and its main constituents against bacterial vaginosis and vulvovaginal candidiasis, their antimicrobial activities against Gardnerella vaginalis and Candida albicans in vitro and their anti-inflammatory effects against G. vaginalis-induced vaginosis and vulvovaginal candidiasis were examined in mice. APEO and its constituents eucalyptol and α-terpineol were found to inhibit microbe growths. α-Terpineol most potently inhibited the growths of G. vaginalis and C. albicans with MIC values of 0.06 and 0.125% (v/v), respectively. The antimicrobial activity of α-terpineol was found to be comparable to that of clotrimazole. Intravaginal treatment with APEO, eucalyptol, or α-terpineol significantly decreased viable G. vaginalis and C. albicans numbers in the vaginal cavity and myeloperoxidase activity in mouse vaginal tissues compared with controls. These agents also inhibited the expressions of proinflammatory cytokines (IL-1β, IL-6, TNF-α, COX-2, INOS, and the activation of NF-κB and increased expression of the anti-inflammatory cytokine IL-10. In addition, they inhibited the expressions of proinflammatory cytokines and the activation of NF-κB in lipopolysaccharide-stimulated peritoneal macrophages, and α-terpineol most potently inhibited the expressions of proinflammatory cytokines and NF-κB activation. Based on these findings, APEO and its constituents, particularly α-terpineol, ameliorate bacterial vaginosis and
CONCLUSION

• Need more data before any solid conclusions can be drawn
• Given a basic gene sets and pathways to investigate further
• Increased expression of IL10 (an anti-inflammatory cytokine)
• BAX and BCL2 are involved in P53-mediated apoptosis
• MME is a membrane metalloendopeptidase that degrades beta-amyloid
CONCLUSION

• This evidence suggests that it could be possible Rosemary EO may be effective for treating arthritis, cramps, and help as a preventative against Alzheimer’s disease
• Gives researchers a candidate gene set to study further (this can save time and money)
FUTURE WORK

• Eliminate noise – look for errors in the data
• Add more expression data
• Drugbank database information on chemicals
• RNA-sequence data (my own)
• Possibility to add machine learning algorithms
ACKNOWLEDGEMENTS

• Dr. Cory Brouwer
• Dr. Jeremy Jay
• UNC Charlotte Bioinformatics Services Division
CITATIONS

• LucidChart.com
MAKING YOUR HEALTH A PRIORITY IN GRAD SCHOOL

By: Aneeta Uppal
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A LITTLE BIT ABOUT ME...

• Chronic Autoimmune urticaria – 2015
  – Xolair injections
  – Side effects...

• Hashimoto’s disease – 2017

• 50% increased chance of developing another autoimmune disease (Multiple sclerosis, Lupus, rheumatoid arthritis) Scary.
WHY ME?!

• I mean I was healthy, physically? I CrossFit all the time!

• I was young?!

• I ate decent, but I wasn’t that strict

• It’s hard to determine what triggered this cascade, but after correcting how I was managing my stress, nutrition, exercise schedule, vitamins and supplements, I’ve seen a huge change
The causes of autoimmune disease are still unknown, but research suggests that it could be a number of things including:

- Genetics
- Viruses
- Toxins
- Environmental pollutants
- Hormonal imbalances
- Leaky gut
- And many other factors
WHAT WAS IN MY CONTROL TO CHANGE?

• Nutrition
• Vitamins and supplements
• Stress management
• Learning to say NO
• Not overloading my schedule
• Listening to my body (over-exercise)
IMPROVEMENT AFTER 2.5 MONTHS

• Thyroid Peroxidase (TPO) Ab
  – Ref Range (0-34 IU/mL)
  – 8/02/17: 204 IU/mL
  – 10/20/17: 193 IU/mL

• Thyroglobulin Antibody
  – Ref: 0.0-0.9 IU/mL
  – 08/02/17: 40.9 IU/mL
  – 10/20/17: 28.8 IU/mL

• Thyroid stimulating hormone (TSH)
  – Ref: 0.450-4.500 IU/mL
  – 08/02/17: 5.580 IU/mL
  – 10/20/17: 3.990 IU/mL
  – 6/25/18: 2.85 IU/mL !!!!
HANDLING STRESS AND FEELING BURNED OUT

• It’s NOT sustainable!

• You NEED sleep and REAL foods

• Sure, you can eat processed foods, not exercise, pull all-nighters but I can promise you you’re not going to feel great or healthy about yourself in the process
EXERCISE IS KEY

• Whatever it is you like – do that!
• Walk in the park
• Kicking around a soccer ball in an empty field
• Yoga
• Running
• Weight lifting
• Get active! You don’t need a gym membership to be active
VOLUNTEERING

• It’s free – and I promise you, you’ll feel good afterwards
• Local shelter and feed meals to those in need
• Animal shelter
• Local rescues and adoption events
• Habitat for humanity
• Teaching opportunities

My foster dogs of 2017
GET OUT MORE

• Grab a friend, go see a movie
• Go out to eat
• Explore the city you are in
• Grad school isn’t mean to be ALL work NO play
• Find a new activity you’ve never done before
• YOU can have a healthy balance!
• Connecting with people will help you in your future careers, you never know who you will run into.
UNWIND & UNPLUG

• We spend too much time on our computers
• Read a book – PUBLIC LIBRARIES ARE GREAT!
• Take a bath
• Listen to a podcast
• Take 5 minutes, anywhere to meditate
• Whatever that interest may be, find it, do it and remove yourself from the rest of the world for a little while
The biggest lie is that healthy foods cost too much. You don’t have to stick to a strict diet but here are some ideas:

- Meal prep
- Crock pot
- Cook bigger batches
- Make a big bowl of salad
- Cut a melon

Fruits, grains, nuts, seeds, fish, meat, vegetables, sprouted grains. Whole, real foods.
Nutrition most importantly has a huge impact on our hormones.

Unbalanced hormones can cause you to feel tired, upset, and feel a whirlwind of different emotions.

- Fatty acids & Omega-3’s
- Stay hydrated
- Avoid added sugars
VITAMINS AND SUPPLEMENTS

• Vitamins and supplements should be kept to a minimum

• Ideal to get those nutrients from whole foods rather than pill form

• Targeted supplements are good for areas of need (ex. Thyroid, adrenal, etc.)

• If you have a known deficiency (iron)
MENTAL HEALTH

• You are not alone
• Your mental health may also be linked to your physical health
• Your school has resources
• You also probably have an ombudsman
  – Get unbiased guidance and opinion
• Make a friend
• National Suicide prevention lifeline: 1-800-273-8255
YOU ARE IMPORTANT!
YOU HAVE A PURPOSE!

• YOU have gotten to where you are because you are GIFTED

• YOU have the power to change the future through your research

• YOU can be a light for someone else in a struggle – someone may be looking up to YOU right now!

• No one else can take better care of you, than you
REFERENCES

• Image Sources:
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