Whole genome sequencing of brewer's yeast isolated in Canadian wineries

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Saccharomyces cerevisiae – species overview

- Used in wine and beer industry
- Genome length: 12 Mbp
- Cell size: 5-10 µm

Opis bioprojektu

Bioproject PRJNA838724

- my aim: does the canadian yeats clade exhibit genetic variants in coding sequences that affect proteins invalueble in the wine industry?
- yeast isolated in Okanagan Valley wine region in British Columbia
- Data was uploaded in 2023
- Ilumina Hi-Seq: pair-ends reads (150 bp / read)
- 75 samples (I used 2 samples x 1 mln reads due to hardware limitations)


JOURNAL ARTICLE

Whole genome sequencing of Canadian *Saccharomyces cerevisiae* strains isolated from spontaneous wine fermentations reveals a new Pacific West Coast Wine clade

R Alexander Marr, Jackson Moore, Sean Formby, Jonathan T Martiniuk, Jonah Hamilton, Sneha Ralli, Kishori Konwar, Nisha Rajasundaram, Aria Hahn, Vivien Measday

Author Notes

Reference genome R64

chr I-XVI
+ mitochondrial

2014

Saccharomyces
cerevisiae S288C

Data Download

Quality Control and Trimming

Alignment

Variant Calling

Biological Consequences

Data Download

All bioproject-associated FASTQ files download

```
-p, --project PRJNAXXXXX
```

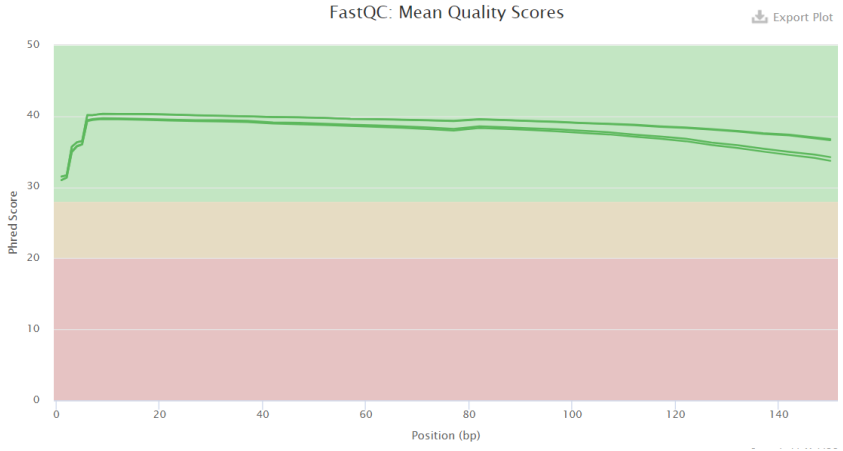
```
sratoolkit:
esearch, efetch, xtract, fastq-dump
```

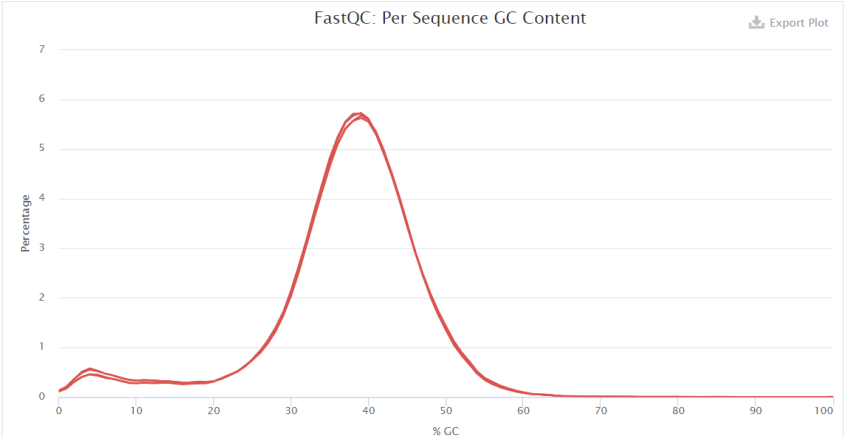
Given SRR-associated FASTQ files download

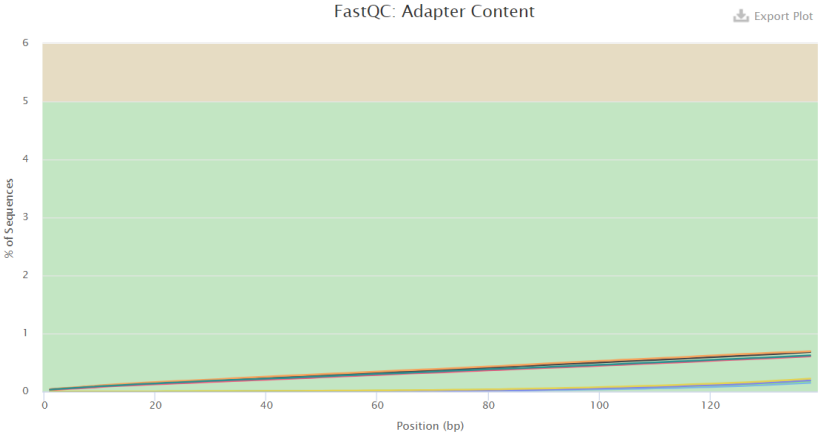
```
-r, --sra SRRXXXXX SRRXXXXX ...
```

```
sratoolkit:
fastq-dump
```

Quality Control

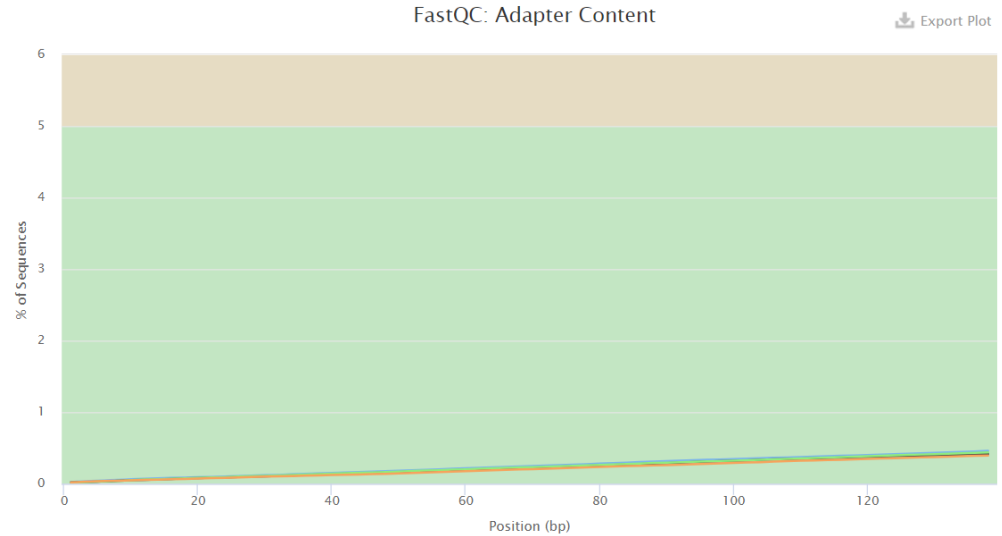


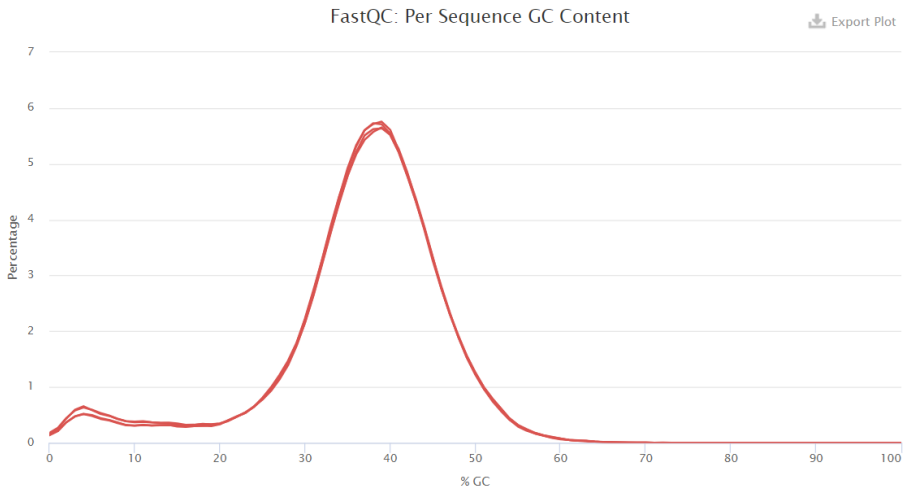




Quality Control

polyA sequences in the genome?

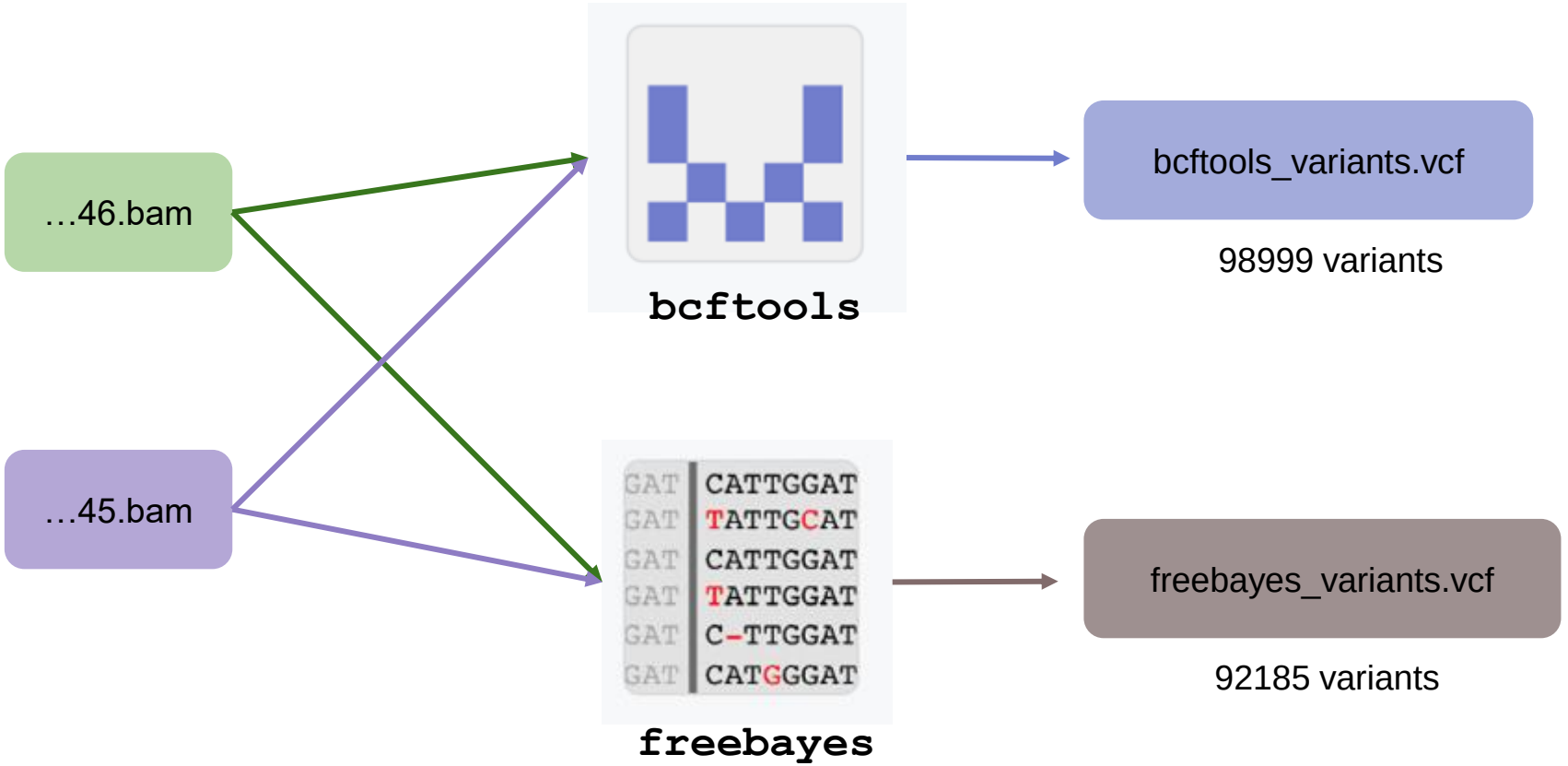




Alignment

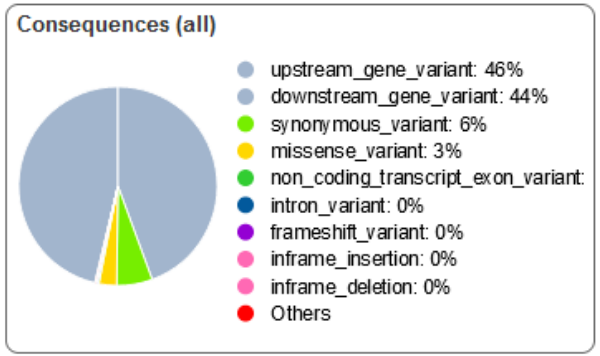
`bwa mem`	Sample 1	Sample 2
Mean coverage	13,88	14,47
Median coverage	11	12
Aligned reads	97,52%	98,76%
Paired	96,29%	97,57%

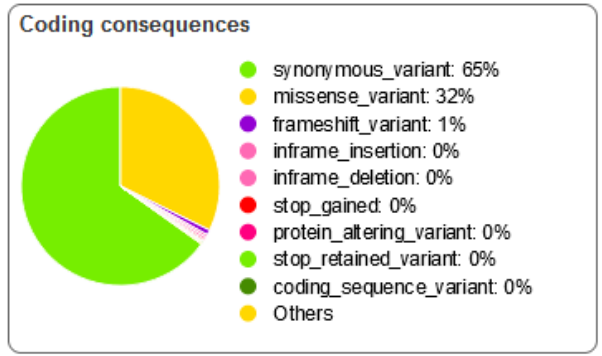
Variant calling



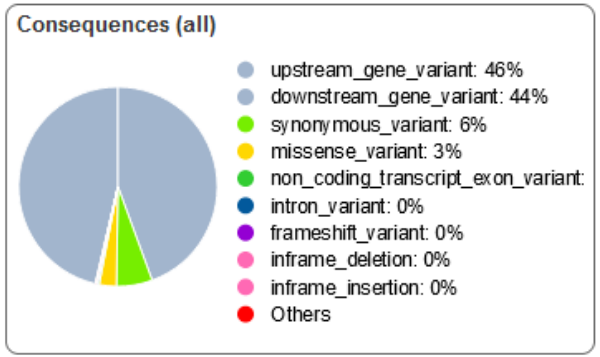
VEP

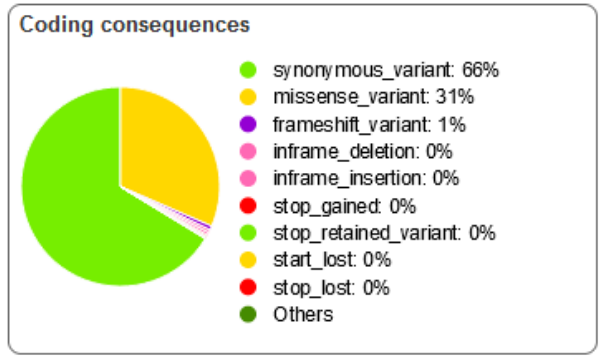
bcftools





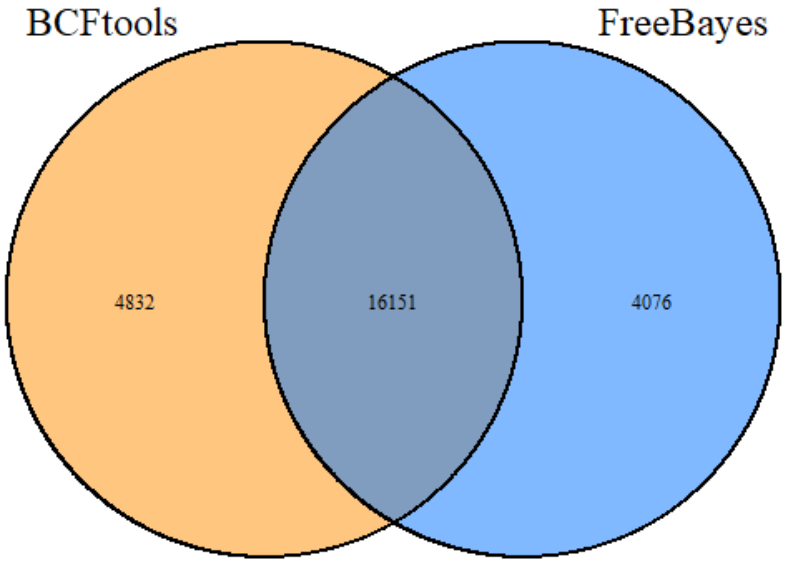
freebayes





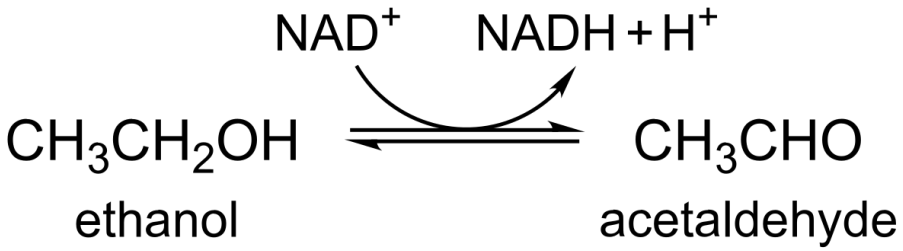
Biological consequences

Consistency of variants detected
by the two programms used in the project

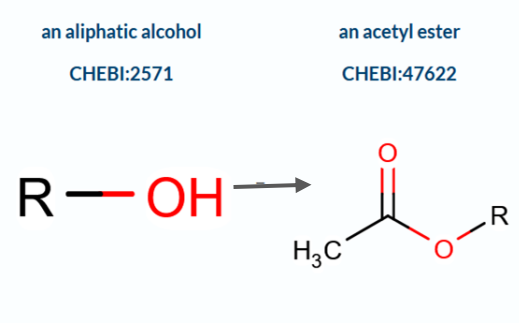


Metabollic pathways crucial for wine industry

Glycolysis + fermentation



Esther metabolism



Biological consequences

YMR318C (ADH1) – Alcohol dehydrogenase

dehydrogenase

ADH1 gene is located on the chromosome XV left arm

- acetate aldehyde reduction to ethanol
- methylglyoksal reduction
- NADH oxidation
- Ethanol production out of broken amino acids

Biological consequences

YMR318C (ADH6)

cinnamyl dehydrogenase

- fusel alcohol synthesis
- aldehyde tolerance

YOR377W (ATF1)

Alcohol actyl-transferase

- acetate esthers production
- terpinyl acetate synthesis

Biological consequences

YCR021C (HSP30) – heat shock protein30 kDa

Cell membrane localization

H(+)-ATPase Pma1p regulator, which impacts pH

Stress response:

- heat shock
- high ethanol concentration,
- low organic acids conentration
- low glucose concentration

Summary

The canadian yeast clade (oakland) apparently exhibits a number of mutations in genes crucial for the wine industry

ADH1
(alcohol fermentation)

ATF1
(esther metabolism)

ADH6
(esther metabolism)

HSP30
(stress response)